Reprinted from Annals of Oriental Research of the University of Madras Volume XXXI Part I

TAMIL AND TELUGU NUMERALS A CONTRASTIVE ANALYSIS

BY

Dr. Pon. KOTHANDARAMAN

TAMIL AND TELUGU NUMERALS
A CONTRASTIVE ANALYSIS

Dr. Pon. KOTHANDARAMAN

Introduction

In the first part of this paper the structure of the numerals is presented. In the second part, transformational rules for both Tamil and Telugu are given and in the third part the morphophonemic rules for Tamil and Telugu are given. Grammatical adequacy is tested in the fourth part.

Tamil is abbreviated as Tm., and Telugu as Tl. The structure of the Tamil numerals and that of the Telugu numerals are almost the same as far as the phrase structure is concerned.

Numeral is abbreviated as Nu. Many symbols such as Nu_a, Nu_b are introduced wherever necessary and all the symbols are explained then and there. Examples are given for both Tamil and Telugu. In the case of compound numerals actual forms which exist in the language can be obtained only after transformational and morphophonemic rules are applied.

I. Phrase Structure

1.1. $Nu \longrightarrow \begin{Bmatrix} Nu_a \\ (Nu_a) + (Nu_1) \end{Bmatrix}$

Nu stands for all numerals and it is expanded as Nu_a and Nu_1. Nu_1 stands for the Tamil (Tm) and Telugu (Tl) numerals from one to nine. In this rule both Nu_a and Nu_1 are optional. When all of the constituents in a constitute are optional, needless to say, atleast one of them should be taken as obligatory so as to make the rule operatable. In such cases it is a convention to write one of the constituents above the constitute. In many of the following rules we have the same situation. Whenever we find all the constituents being optional in a constitute we have to choose one among them as obligatory. Henceforth one of

the constituents will not be written above the constitute and the statement given here will take care of it.

For instance the next rule has to be written as

$$Nu_a \longrightarrow \begin{Bmatrix} Nu_b \\ (Nu_b) + (Nu_2) \end{Bmatrix}$$

Instead of this let us write it as

$$Nu_a \longrightarrow (Nu_b) + (Nu_2).$$

Both rules mean the same thing.

Nu_a stands for all the numerals other than the items covered by Nu_1 and Nu_a will be expanded in the next rule.

Ex. Nu_1

Tm. Onṟu One

Tl. Okaṭi ,,

1.2. $Nu_a \longrightarrow (Nu_b) + (Nu_2)$

Nu_2 stands for the multiples of ten, i.e., ten, twenty, thirty, etc. Nu_2 can be followed by the constituent Nu_1. Nu_b is the cover symbol for all the numerals other than those covered by $(Nu_2) + (Nu_1)$.

Ex. Nu_2

Tm. pattu ten

Tl. padi ,,

$Nu_2 + Nu_1$

Tm. pattu onṟu eleven

Tl. padi okaṭi ,,

1.3. $Nu_b \longrightarrow (Nu_c) + (nu_3)$

Nu_3 represents all the multiples of hundred and Nu_c other than those covered by Nu_3, Nu_2 and Nu_1. Nu_3 may be followed by Nu_2 as well as Nu_1. Nu_3 may also be followed by Nu_2 and Nu_1 together.

Ex. Nu_3

Tm. nuuṟu hundred

Tl. onda hundred

$Nu_3 + Nu_2$

Tm. nuuṟu - muppatu hundred and thirty

Tl. onda - mupphai hundred and thirty

$Nu_3 + Nu_2 + Nu_1$

Tm. irunuuṟu - pattu - aaṟu two hundred and sixteen

Tl. reṇḍondalu - padi - aaru two hundred and sixteen

$Nu_3 + Nu_1$

Tm. nuuṟu - eṭṭu hundred and eight

Tl. onda - enimidi ,,

1.4. $Nu_c \longrightarrow (Nu_d) + (Nu_4)$

Nu_4 stands for the multiples of thousand and Nu_d for the items other than the ones covered by Nu_4, Nu_3, Nu_2 and Nu_1. Nu_4 can be followed by Nu_3, Nu_2 or by Nu_1 and it can also be followed by any two of the items, or by all three. But the sequence should be in the order, 'from the higher to the lower'. For instance Nu_2 can be followed by Nu_1 but never by Nu_3, nor by Nu_4. Thus $Nu_3 + Nu_2 + Nu_1$ is possible but $Nu_2 + Nu_3 + Nu_4$ is not possible.

Ex. Nu_4

Tm. aayiram thousand

Tl. Veyyi thousand

$Nu_4 + Nu_3$

Tm. aayiram - irunuuṟu 1,200

Tl. Veyyi - reṇḍondalu 1,200

$Nu_4 + Nu_2$

Tm. aayiram - irupatu 1,020

Tl. Veyyi - iravai 1,020

$Nu_4 + Nu_1$

Tm. aayiram - eṭṭu 1,008

Tl. Veyyi - enimidi 1,008

$Nu_4 + Nu_3 + Nu_2$

Tm. aayiram - irunuuṟu - aympatu 1,250

Tl. veyyi - reṇḍondalu - eebai 1,250

$Nu_4 + Nu_3 + Nu_1$

Tm. aayiram - irunuuṟu - eṭṭu	1,208
Tl. Veyyi - reṇḍondalu - enimidi	1,208

$Nu_4 + Nu_2 + Nu_1$

Tm. aayiram - muppatu - aaṟu	1,036
Tl. veyyi - mupphai - aaru	1,036

$Nu_4 + Nu_3 + Nu_2 + Nu_1$

Tm. aayiram - irunuuṟu - muppatu - aaṟu	1,236
Tl. Veyyi - reṇḍondalu - muppai - aaru	1,236

1.5. $Nu_d \longrightarrow (Nu_e) + (Nu_5)$

Nu_5 stands for all the multiples of lakh and Nu_e for the rest which is to be expanded in the following sections. Nu_5 can be followed by one or more of the constituents in the order explained in 1.4.

Ex. Nu_5

Tm. ilaṭcam	100,000
Tl. lakṣa	100,000

$Nu_5 + Nu_4$

Tm. ilatcam - muppataayiram	130,000
Tl. lakṣa - mupphaiveelu	130,000

$Nu_5 + Nu_3$

Tm. ilaṭcam - munnuuṟu	100,300
Tl. lakṣa - muuḍondalu	100,300

$Nu_5 + Nu_2$

Tm. ilaṭcam - pattu	100,010
Tl. lakṣa - padi	100,010

$Nu_5 + Nu_1$

Tm. ilaṭcam - aaru	100,006
Tl. lakṣa - aaru	100,006

$Nu_5 + Nu_4 + Nu_3$

Tm. ilaṭcam - muuvaayiram - munnuuṟu	103,300
Tl. lakṣa - muuḍuveelu - munḍondalu	103,300

$Nu_5 + Nu_4 + Nu_2$

Tm. ilaṭcam - muuvaayiram - pattu	103,010
Tl. lakṣa - muuḍaveelu - padi	103,010

$Nu_5 + Nu_4 + Nu_1$

Tm. aaṟilatcam - muuvaayiram - naaṉku 603,004
Tl. aarulakṣalu - muuḍuveelu - naalugu 603,004

$Nu_5 + Nu_3 + Nu_2$

Tm. aaṟilaṭcam - nuuru - pattu 600,110
Tl. aaṟulakṣalu - onda - padi 600,110

$Nu_5 + Nu_3 + Nu_1$

Tm. ayntiḷaṭcam - nuuṟu - eṭṭu 500,108
Tl. ayḋulakṣalu - onda - enimidi 500,108

$Nu_5 + Nu_2 + Nu_1$

Tm. ayntiḷaṭcam - irupatu - aaṟu 500,026
Tl. ayḋulakṣalu - iravai - aaru 500,026

$Nu_5 + Nu_4 + Nu_3 + Nu_2$

Tm. aaṟilaṭcam - pattaayiram - munnuuṟu - muppatu 610,330
Tl. aarulakṣalu - padiveelu - muuḍondalu - muppai 610,330

$Nu_5 + Nu_4 + Nu_3 + Nu_1$

Tm. eṭṭilaṭcam - pattaayiram - munnuuṟu - eṭṭu 810,308
Tl, enimidilakṣalu - padiveelu - muuḍondalu - enimidi 810,308

$Nu_5 + Nu_4 + Nu_2 + Nu_1$

Tm. eeḷilaṭcam - irupataayiram - irupatu - oṉṟu 720,021
Tl. eeḍulakṣalu - iravaiveelu - iravai - okaṭi 720,021

$Nu_5 + Nu_4 + Nu_3 + Nu_2 + Nu_1$

Tm. eṭṭilateam - eḷupataayiram - aṟunuuṟu - aympatu - naaṉku 870,654
Tl. enimidilakṣalu - debbhaiveelu - aarondalu - eebhai naalugu 870,654

1.6. $Nu_6 \longrightarrow (Nu) + \begin{Bmatrix} \text{Tm. } \textit{Kooṭi} \\ \text{Tl. } \textit{Kooṭi} \end{Bmatrix}$

Nu_6 is expanded as Nu plus *Kooṭi* for Tamil and Nu plus *Kooṭi* for Telugu. Since *Kooṭi* is the terminal string it is not to be expanded further. Here Nu occurs again which is being

expanded from 1.1 to 1.6 The rule 1.6 is technically called recursive rule. Nu can be expanded once again as Nu $\longrightarrow$ $(Nu_a) + (Nu_1)$, $Nu_a \longrightarrow (Nu_b) + (Nu_2)$ and so on.

Kooṭi can be followed by Nu_5, Nu_4, Nu_3, Nu_2 or Nu_1 and it can also be followed by one or more of the constituents; but in the order, from the higher to the lower (as explained in 1.4). Needless to say that *Kooṭi* can be followed by all of them.

Ex. Nu_e

Tm.	*Kooṭi*	10,000,000
Tl.	*Kooṭi*	10,000,000

$Nu_e + Nu_5$

Tm.	aaṟukooṭi - aaṟilaṭcam	60,600,000
Tl.	aarukooṭilu - aarulakṣalu	60,600.000

$Nu_e + Nu_4$

Tm.	aaṟukooṭi - aṟupataayiram	60,060,000
Tl.	aarukooṭilu - aravaiveelu	60,060,000

$Nu_e + Nu_3$

Tm.	aaṟukooṭi - aṟunuuṟu	60,000,600
Tl.	aarukooṭilu - aarondalu	60,000,600

$Nu_e + Nu_2$

Tm.	aaṟukooṭi - aṟupatu	60,000,060
Tl.	aarukooṭilu - aravai	60,000,060

$Nu_e + Nu_1$

Tm.	aaṟukooṭi - eṭṭu	60,000,008
Tl.	aarukooṭilu - enimidi	60,000,008

$Nu_e + Nu_5 + Nu_4$

Tm.	aaṟukooṭi - aaṟilaṭcam - aaṟaayiram	60,606,000
Tl.	aarukooṭilu - aarulakṣalu - aaruveelu	60,606,000

$Nu_e + Nu_5 + Nu_3$

Tm.	aaṟukooṭi - aaṟilaṭcam - aṟunuuṟu	60,600,600
Tl.	aarukooṭilu - aarulakṣalu - aarondalu	60,600,600

$Nu_e + Nu_5 + Nu_2$

Tm.	aaṟukooti - aaṟilaṭcam - aṟupatu	60,600,060
Tl.	aarukooṭilu - aarulakṣalu - aravai	60,600,060

$Nu_8 + Nu_6 + Nu_1$

Tm.	aaŗukooţi - aaŗilaţcam - aaŗu	60,600,006
Tl.	aarukooţilu - aarulakşalu - aaru	60,600,006

$Nu_8 + Nu_4 + Nu_3$

Tm.	aaŗukooţi - aaŗaayiram - aŗunuuŗu	60,006,600
Tl.	aarukooţilu - aaruveelu - aaroṇḍalu	60,006,600

$Nu_8 + Nu_4 + Nu_2$

Tm.	aaŗukooţi - aaŗaayiram - irupatu	60,006,020
Tl.	aarukooţilu - aaruveelu - iravai	60,006,020

$Nu_8 + Nu_4 + Nu_1$

Tm.	aarukooţi - aaŗaayiram - eţţu	60,006,008
Tl.	aarukooţilu - aaruveelu - enimidi	60,006,008

$Nu_8 + Nu_3 + Nu_2$

Tm.	aaŗukkooţi - aŗunuuŗu - aŗupatu	60,000,660
Tl.	aarukooţilu - aarondalu - aravai	60,000,660

$Nu_8 + Nu_3 + Nu_1$

Tm.	aaŗukooţi - aŗunuuŗu - aaŗu	60,000,606
Tl.	aarukooţilu - aarondalu - aaru	60,000,606

$Nu_8 + Nu_2 + Nu_1$

Tm.	aaŗukooţi - aŗupatu - aaŗu	60,000,066
Tl.	aarukooţilu - aravai - aaru	60,000,066

$Nu_8 + Nu_6 + Nu_4 + Nu_3$

Tm.	aaŗukooţi - aaŗilaţcam - aaŗaayiram - aŗunuuŗu	60,606,600
Tl.	aarukooţilu - aarulakşalu - aaruveelu - aarondalu	60,606,600

$Nu_8 + Nu_6 + Nu_4 + Nu_2$

Tm.	aaŗukooţi - aaŗilaţcam - aaŗaayiram - aŗupatu	60,606,060
Tl.	aarukooţilu - aarulakşalu - aaruveelu - aravai	60,606,060

$Nu_8 + Nu_6 + Nu_4 + Nu_1$

Tm.	aaŗukooţi - aaŗilaţcam - aaŗaayiram - aaŗu	60,606,006
Tl.	aarukooţilu - aarulakşalu - aaruveelu - aaru	60,606,006

$Nu_6 + Nu_5 + Nu_3 + Nu_2$

Tm. aaṟukooṭi - aaṟilaṭcam - aṟunuuṟu - aṟupatu 60,600,660

Tl. aarukooṭilu - aarulakṣalu - aarondalu - aravai 60,600,660

$Nu_6 + Nu_5 + Nu_3 + Nu_1$

Tm. aaṟukooṭi - aaṟilaṭcam - aṟunuuṟu - eṭṭu 60,600,608

Tl. aarukooṭilu - aarulakṣalu - aarondalu - enimidi 60,600,608

$Nu_6 + Nu_5 + Nu_2 + Nu_1$

Tm. aaṟukooṭi - aaṟilaṭcam - aṟupatu - aaṟu 60,600,066

Tl. aarukooṭilu - aarulakṣalu - aravai - aaru 60,600,066

$Nu_6 + Nu_4 + Nu_3 + Nu_2$

Tm. aaṟukooṭi - aaṟaayiram - aṟunuuṟu - aṟupatu 60,006,660

Tl. aarukooṭilu - aaruveelu - aarondalu - aravai 60,006,660

$Nu_6 + Nu_4 + Nu_3 + Nu_1$

Tm. aaṟukooṭi - aaṟaayiram - aṟunuuṟu - aaṟu 60,006,606

Tl. aarukooṭilu - aaruveelu - aarondalu - aaru 60,006,606

$Nu_6 + Nu_3 + Nu_2 + Nu_1$

Tm. aaṟukooṭi - aṟunuuṟu - aṟupatu - aaṟu 60,000,666

Tl. aarukooṭilu - aarondalu - aravai - aaru 60,000,666

$Nu_6 + Nu_5 + Nu_4 + Nu_3 + Nu_2$

Tm. aaṟukooṭi - aaṟilaṭcam - aaṟaayiram - aṟunuuṟu - aṟupatu 60,606,660

Tl. aarukooṭilu - aarulakṣalu - aaruveelu - aarondalu - aravai 60,606,660

$Nu_6 + Nu_5 + Nu_4 + Nu_3 + Nu_1$

Tm. aaṟukooṭi - aaṟilaṭcam - aaṟaayiram - aṟunuuṟu - aaṟu 60,606,606

Tl. aarukooṭilu - aarulakṣalu - aaruveelu - aarondalu - aaru **60,606,606**

$Nu_6 + Nu_5 + Nu_4 + Nu_2 + Nu_1$

Tm. aaṟukooṭi - aaṟilaṭcam - aaṟaayiram - aṟupatu - aaṟu **60,606,066**

Tl. aarukooṭilu - aarulakṣalu - aaruveelu - aravai - aaru **60,606,066**

$Nu_6 + Nu_5 + Nu_3 + Nu_2 + Nu_1$

Tm. aaṟukooṭi - aaṟilaṭcam - aṟunuuṟu - aṟupatu - aaṟu **60,600,666**

Tl. aarukooṭilu - aarulakṣalu - aarondalu - aravai - aaru **60,600,666**

$Nu_6 + Nu_4 + Nu_3 + Nu_2 + Nu_1$

Tm. aaṟukooṭi - eṭṭaayiram - eḻunuuṟu - irupatu - aaṟu **60,008,726**

Tl. aarukooṭilu - enimidiveelu - eeḍondalu - iravai - aaru **60,008,726**

$Nu_6 + Nu_5 + Nu_4 + Nu_3 + Nu_2 + Nu_1$

Tm. aaṟukooṭi - aṟupattaaṟilaṭcam - aympattunaalaayiram - munnuuṟu - muppatu - iraṇṭu **66,654,332**

Tl. aarukooṭilu - aravaiyaarulakṣalu - eebainaaluyuveelu - muudondalu - muppai - reṇḍu **66,654,332**

Examples are given exhaustively for the items following kooṭi. Kooṭi can also be preceded by Nu. The following are the examples.

Nu_1 + *Kooṭi*

Tm. muuṉṟu - kooṭi **30,000,000**

Tl. muuḍu - kooṭilu **30,000,000**

Nu_2 + *Kooṭi*

Tm. irupatu - kooṭi **200,000,000**

Tl. iravai - kooṭilu **200,000,000**

Nu_3 + *Kooṭi*

Tm. irunuuṟu - kooṭi	2,000,000,000
Tl. reṇḍondalu - kooṭilu	2,000,000,000

Nu_4 + *Kooṭi*

Tm. iraṇṭaayiram - kooṭi	20,000,000,000
Tl. reṇḍuveelu - kooṭilu	20,000,000,000

Nu_5 + *Kooṭi*

Tm. muunṟilaṭcam - kooṭi	3,000,000,000,000
Tl. muuḍulakṣalu - kooṭilu	3,000,000,000,000

Nu_2 + Nu_1 + *Kooṭi*

Tm. pattu - aaṟu - kooṭi	160,000,000
Tl. padi - aaru - kooṭilu	160,000,000

Nu_3 + Nu_1 + *Kooṭi*

Tm. nuuṟu - aaṟu - kooṭi	1,060,000,000
Tl. onda - aaru - kooṭilu	1,060,000,000

Nu_4 + Nu_1 + *Kooṭi*

Tm. aaṟaayiram - aaṟu - kooṭi	60,060,000,000
Tl. aaruveelu - aaru - Kooṭilu	60,060,000,000

Nu_5 + Nu_1 + *Kooṭi*

Tm. aaṟilaṭcam - aaṟu - kooṭi	6,000 060,000,000
Tl. aarulakṣalu - aaru - kooṭilu	6,000,060,000,000

Nu_3 + Nu_2 + Nu_1 + *Kooṭi*

Tm. munnuuṟu - irupatu - aaṟu - kooṭi	3,260,000,000
Tl. muuḍondalu - iravai - aaru - kooṭilu	3,260,000,000

Nu_4 + Nu_2 + Nu_1 + *Kooṭi*

Tm. iraṇṭaayiram - irupatu - aaṟu - kooṭi	20,260,000,000
Tl. reṇḍuveelu - iravai - aaru - kooṭilu	20,260,000,000

Nu_5 + Nu_2 + Nu_1 + *Kooṭi*

Tm. aaṟilaṭcam - aṟupatu - aaṟu - kooṭi	6,000,660,000,000
Tl. aarulakṣalu - aravai - aaru - kootilu	6,000,660,000,000

$Nu_4 + Nu_3 + Nu_2 + Nu_1 +$ *Kooṭi*

Tm. ayntaayiram - munnuuṟu - iṟupatu - oṉṟu - kooṭi 53,210,000,000

Tl. ayduveelu - muuḍondalu - iravai - okaṭi - kooṭilu 53,210,000,000

$Nu_5 + Nu_3 + Nu_2 + Nu_1 +$ *Kooṭi*

Tm. muuṉṟilaṭcam - munnuuṟu - iṟupatu - aaṟu - kooṭi 3,003,260,000,000

Tl. muuḍulakṣalu - muuḍondalu - iravai - aaṟu - kooṭilu 3,003,260,000,000

$Nu_6 + Nu_4 + Nu_3 + Nu_2 + Nu_1 +$ *Kooṭi*

Tm. muuṉṟilaṭcam - aaṟaayiram - aṟunuuṟu - iṟupatu - muuṉṟu - Kooṭi 3,066,230,000,000

Tl. muuḍulaksalu - aaruveelu - aarondalu - iravai - muuḍu - kooṭilu 3,066,230,000,000

$Nu_6 + Nu_4 +$ *Kooṭi*

Tm. aaṟilaṭcam - aaṟaayiram - kooṭi 6,060,000,000,000

Tl. aarulakṣalu - aaruveelu - kooṭilu 6,060,000,000,000

$Nu_6 + Nu_3 +$ *Kooṭi*

Tm. aaṟilaṭcam - aṟunuuṟu - kooṭi 6,006,000,000,000

Tl. aarulakṣalu - aarondalu - kooṭilu 6,006,000,000,000

$Nu_6 + Nu_2 +$ *Kooṭi*

Tm. aaṟilaṭcam - aṟupatu - kooṭi 6,000,600,000,000

Tl. aarulakṣalu - aravai - kooṭilu 6,000,600,000,000

$Nu_6 + Nu_1 +$ *Kooṭi*

Tm. oṉpatilaṭcam - oṉpatu - kooṭi 9,000,090,000,000

Tl. tommidilakṣalu - tommidi - kooṭilu 9,000,090,000,000

$Nu_6 + Nu_4 + Nu_3 +$ *Kooṭi*

Tm. oṉpatilatcam - oṉpataayiram - aṟunuuṟu - kooṭi 9,096,000,000,000

Tl. tommidilakṣalu - tommidiveelu - aarondalu - kooṭilu 9,096,000,000,000

$Nu_5 + Nu_4 + Nu_2 +$ *Kooṭi*

Tm. oṉpatilaṭcam - oṉpataayiram - eḷupatu - kooṭi 9,090,700,000,000

Tl. tommidilakṣalu - tommidiveelu - debbai - kooṭilu 9,090,700,000,000

$Nu_5 + Nu_4 + Nu_1 +$ *Kooṭi*

Tm. oṉpatilaṭcam - oṉpataayiram - aaṟu - kooṭi 9,090,060,000,000

Tl. tommidilakṣalu - tommidiveelu - aaru - kooṭilu 9,090,060,000,000

$Nu_4 + Nu_3 + Nu_2 +$ *Kooṭi*

Tm. Oṉpataayiram - munnuuru - paṭṭu kooṭi 93,100,000,000

Tl. tommidiveelu - muuḍondalu - padi kooṭilu 93,100,000,000

$Nu_4 + Nu_2 +$ Kooti

Tm. Oṉpataayiram - pattu - kooṭi 90,100,000,000

Tl. tommidiveelu - padi - kooṭilu 90,100,000,000

In this analysis we have arbitrarily chosen *kooṭikooṭi* as the maximum unit in numerals. Nu_6 is expanded as (Nu) + Kooti. By this rule we get the maximum unit *kooṭikooṭi* and beyond that this recursive rule will not operate. Naturally, we do not find any numeral beyond the unit *kooṭikooṭi*. Even this is arbitrarily chosen by the author for this is the maximum unit in all probability that one can find in the languages (both Tamil and Telugu).

Ex. Kooṭi + Kooṭi

Tm. Kooṭi - kooṭi 100,000,000,000,000

Tl. Kooṭilu - kooṭilu 100,000,000,000,000

Note the order when *kooṭi* is preceded by other constituents. Also note the order when it is followed by other constituents.

$Nu_5 + Nu_4 + Nu_3 + Nu_2 + Nu_1 +$ Kooti $+ Nu_5 + Nu_4 + Nu_3 + Nu_2 + Nu_1$

Kooṭi cannot be preceded by $Nu_2 + Nu_4$ nor by $Nu_1 + Nu_2$. In other words *kooṭi* is preceded by other constituents in the order, from the lower to the higher whereas it is followed by them in the order, from the higher to the lower. *Kooṭi* can be preceded by one or more of the constituents in the order mentioned here.

The following are the examples for the numeral where *kooṭi* is followed as well as preceded by all other constituents.

Ex. 1

Kooṭi + Nu_5 + Nu_4 + Nu_3 + Nu_2 + Nu_1 + kooti + Nu_5 + Nu_4 + Nu_3 + Nu_2 + Nu_1

Tm. Kooṭi - eḻupattaaṟilaṭcam - aṟupattayyayiram
naaṉuuṟu - muppatu - iraṇṭu - kooṭi -
patiṉayntilaṭcam - irupattunaalaayiram - munnuuṟu -
irupatu - oṉṟu 176,654,321,524,321

Tl. Kooṭi - ḍebbhaiyaarulakṣalu - aravaiyayduveelu -
naalugondalu - mupphai - reṇḍu - kooṭilu -
padiheenulakṣalu - iravainaalugu veelu - muuḍondaiu -
iravai - okaṭi 176,654,321,524,321

Ex. 2.

Tm. oṉpatu kooṭi - toṇṇuuṟṟoṉpatilaṭcam - toṇṇuuṟṟoṉ-
pataayiram - toḷḷaayiram - toṇṇuuṟu - oṉpatu - kooti -
toṇṇuuṟṟoṉpatilaṭcam - toṇṇuuṟṟoṉpataayiram -
toḷḷaayiram - toṇṇuuṟu - oṉpatu 999,999,999,999,999

Tl. tommidikooṭilu - tombhaitommidi lakṣalu - tombhai-
tommidiveelu - tommidondalu - tombhai - tommidi -
kooṭilu - tombhai tommidi lakṣalu - tombhai
tommidiveelu tommidondalu - tombhai -
tommidi 999,999,999,999,999

It is common to get *kooṭi* being followed by other constituents when it is preceded by any of the following

(1) Nu_1	(4) $Nu_2 + Nu_1$
(2) Nu_2	(5) $Nu_3 + Nu_1$
(3) Nu_3	(6) $Nu_3 + Nu_2$
	(7) $Nu_3 + Nu_2 + Nu_1$

When *kooṭi* is preceded by Nu_4, Nu_5 and *kooṭi*, in the natural language, we do not find other constituents following *kooṭi*. In such cases the units which are lower than *kooṭi* are usually omitted. For instance when one gets the numeral 40,000,000,600 he will not say naalaayirankooṭiyee aṛunuuṛu but only naalaayirankooti. Such restrictions are not dealt with in this analysis.

$$1.7.\quad Nu_5 \longrightarrow (Nu_m) + \begin{Bmatrix} \text{Tm. } \textit{ilaṭcam} \\ \text{Tl. } \textit{lakṣa} \end{Bmatrix}$$

Nu_5 which is one of the expanded items of Nu_d is expanded here as (Nu_m) + *ilaṭcam* for Tamil and (Nu_m) + *lakṣa* for Telugu. Nu_m is again expanded in the following section and examples are given there.

$$1.8.\quad Nu_m \longrightarrow \begin{Bmatrix} (Nu_1 \\ (Nu_2) + (Nu_1) \end{Bmatrix}$$

In this rule both Nu_2 and Nu_1 are optional: but one of them should be taken so that the rule can be made operatable. When we operate this rule, Nu_m in 1.7 is replaced and we get the following sequence:

$(Nu_2) + (Nu_1)$ + Tm. *ilaṭcam*
Tl. *lakṣa*

Nu_2 stands for the multiples of ten and Nu_1 for the items from one to nine. These constituents will be expanded in the following sections, 1.11 and 1.12.

Ex. $Nu_2 + Nu_1$ + Tm. *ilaṭcam*
Tm. eṇpatu - eṭṭu - ilaṭcam — 8,800,000
$Nu_2 + Nu_1$ + Tl. lakṣa
Tl. enabhai - enimidi - *lakṣalu* — 8,800,000
Nu_1 + Tm. ilaṭcam
Tl. lakṣa
Tm. eṭṭu - ilaṭcam — 800,000
Tl. enimidi - lakṣalu — 800,000

$$1.9.\quad Nu_4 \longrightarrow (Nu_m) + \begin{Bmatrix} \text{Tm. } \textit{aayiram} \\ \text{Tl. } \textit{veyyi} \end{Bmatrix}$$

Nu_m is an abbreviation for (Nu_2) + (Nu_1) which is explained in the previous section.

Ex. Nu_2 + Nu_1 + Tm. *aayiram*
Tl. *veeyi*

Tm. eṉpatu - eṭṭu - aayiram	88,000
Tl. enabhai - enimidi - veelu	88,000

Nu_1 + Tm. aayiram
Tl. veeyi

Tm. eṭṭu - aayiram	8,000
Tl. enimidi - veelu	8,000

Nu_2 + Tm. aayiram
Tl. veyyi

Tm. eṉpatu - aayiram	80,000
Tl. enabhai - veelu	80,000

1.10. Nu_3 ⟶ (Nu_1) + {Tm. *nuuṟu* / Tl. *onda*}

It is already stated that Nu_1 stands for the items from one to nine.

Ex. Nu_1 + Tm. *nuuṟu*
Tl. *onda*

Tm. eṭṭu - nuuṟu	800
Tl. enimidi - ondalu	800

1.11. Nu_2 ⟶ (Nu_1) + {Tm. pattu / Tl. padi}

Ex. Nu_1 + Tm. pattu
Tl. padi

Tm. aaṟu - pattu	60
Tl. aaru - padi	60

1.12. Nu_1 ⟶ {Tm. oṉṟu, iraṇṭu, muuṉṟu, naaṉku, ayndu, aaṟu, eeḷu, eṭṭu, oṉpatu / Tl. okaṭi, reṇḍu, muuḍu, naalugu, aydu, aaṟu, eeḍu, enimidi, tommidi}

II. TRANSFORMATION

2.0. In this second part of the analysis, all the transformational rules are given. In order to get *toṉṉuuṟu* in Tamil we have *oṉpatu + pattu* in the input. *Oṉpatu + pattu* has given *toṉṉuuṟu* and *oṉpatu + nuuṟu, toḷḷaayiram.* All such cases are treated under this head.

2.1. Tm.

$$\left[\text{Oṉṟu} + \left\{\begin{matrix} \left\{\begin{matrix}\text{Ilaṭcam}\\ \text{aayiram}\end{matrix}\right\} \\ \left\{\begin{matrix}\text{kooṭi}\\ \text{nuuṟu}\end{matrix}\right\} \\ \text{pattu}\end{matrix}\right\}\right] \Rightarrow \left[\begin{matrix} \text{(oor)} + \left\{\begin{matrix}\text{ilaṭcam}\\ \text{aayiram}\end{matrix}\right\} \\ \text{(oru)} + \left\{\begin{matrix}\text{Kooṭi}\\ \text{nuuṟu}\end{matrix}\right\} \\ \left\{\begin{matrix}\text{oru patu}\\ \text{pattu}\end{matrix}\right\}\end{matrix}\right]$$

Tl.

$$\left[\text{Okaṭi} + \left\{\begin{matrix}\text{Kooṭi}\\ \text{lakṣa}\\ \text{veyyi}\\ \text{onda}\\ \text{padi}\end{matrix}\right\}\right] \Rightarrow \left[\text{(Oka)} + \left\{\begin{matrix}\text{Kooṭi}\\ \text{lakṣa}\\ \text{veyyi}\\ \text{onda}\\ \text{padi}\end{matrix}\right\}\right]$$

In Tamil *oru kooṭi ruupaay* and *kooṭi ruupaay* make no difference in meaning. So also in Telugu *oka kooṭi ruupaayi(lu)* and *kooṭi ruupaayi(lu)* make no difference in meaning. Same is the case for lakh, thousand, hundred and ten.

Ex. Tm.

oru kooṭi	or	kooṭi
oorilaṭcam	or	ilaṭcam
ooraayiram	or	aayiram
orunuuṟu	or	nuuṟu
orupatu	or	pattu

Orunuuṟu and *orupatu* are rare but found in the language. *Oorilaṭcam* has another alternant *oru laṭcam* and *ooraayiram* has another form oru aayiram. Provision is not made here for those excepitonal items.

Ex. Tl.

Oka kooṭi	or	kooṭi
oka lakṣa	or	lakṣa
oka veyyi	or	veyyi
oka onda	or	onda
oka padi	or	padi

Onda has another equivalent, *nuuru* which is obtained by an optional transformational rule; *nuuru* will not occur after a numeral adjective where *onda* will occur. In Telugu initial *O* - is also pronounced as *wa* - and so *onda* may be pronounced as *wanda*.

2.2. Tm.

$$\begin{bmatrix}\text{(oru) Kooṭi} \\ \text{(oor) ilaṭcam}\end{bmatrix} + X \Rightarrow \begin{bmatrix}\text{oru - kootiyee} \\ \text{oor - ilatcattu}\end{bmatrix} + X$$

Tl.

$$\text{(oka)} + \begin{bmatrix}\text{kooṭi} \\ \text{laksa}\end{bmatrix} + X \Rightarrow \text{oka} + \begin{bmatrix}\text{kooṭi} \\ \text{lakṣa}\end{bmatrix} + X$$

When *kooṭi* and *ilaṭcam* are followed by another numeral not only will they respectively take - *ee* and - *attu* but the morphemes *oru* and *oor* which are optionally chosen will become obligatory. So also *oka* will become obligatory in Telugu when *kooṭi* and *lakṣa* are followed by another numeral.

Here x is a dummy symbol denoting all the numerals that can occur after *kooṭi* and *ilaṭcam* of Tamil and *kooṭi* and *lakṣa* of Telugu.

2.3. Tm. Opt.

$$\begin{bmatrix}\text{pattu} \\ \text{- patu}\end{bmatrix} + \text{aayiram} \Rightarrow \text{patin̲} + \text{aayiram}$$

pattu - aayiram will give *pattaayiram* or *patin̲aayirom*. The latter is treated here. *naaṟpatu - aayiram* will give *naaṟpataayiram* or *naaṟpatin̲aayiram*. The latter is obtained by this rule.

2.4. Tl. Opt.

Oka + onda ⇒ nuuru

nuuru is also found in Telugu in addition to *onda*. But *oka nuuru* is not possible. In other words *nuuru* occurs when it is not preceded by any numeral. When *nuuru* is followed by other numerals it will be changed into *nuuṭa* - and this will be dealt with later on.

2.5.1. Tl.

$$x_1 + \begin{bmatrix} \text{kooṭi} \\ \text{lakṣa} \\ \text{veyyi} \\ \text{onda} \end{bmatrix} \Rightarrow x_1 + \begin{bmatrix} \text{kooṭi} \\ \text{lakṣa} \\ \text{veyyi} \\ \text{onda} \end{bmatrix} + \text{-lu}$$

x_1 stands for the numbers (except *okaṭi*) which occur before *kooṭi, lakṣa,* etc.

Ex. reṇḍu + kooṭi —→ reṇḍu + kooṭi + lu
padi + lakṣa —→ padi + lakṣa + lu
aaru + veyyi —→ aaru + veyyi + lu
muuḍu + onda —→ muuḍu + onda + lu

2.5.2. Tl.

Veyyi + lu ⇒ veelu

Ex. rendu + veyyi + lu → rendu + veelu
padi + veyyi + lu → padi + veelu

There is no correspondence in Tamil for the addition of the suffix *-lu* in Telugu.

2.6.1. Tm.

(a)
$$\begin{bmatrix} \text{iraṇṭu} \\ \text{muuṉṟu} \\ \text{naaṉku} \\ \text{ayntu} \\ \text{aaṟu} \\ \text{eeḷu} \\ \text{eṭṭu} \end{bmatrix} + \begin{bmatrix} \text{pattu} + \text{Nu}_1 \\ \\ \\ \\ \\ \\ \text{pattu} \end{bmatrix} \Rightarrow \begin{bmatrix} \text{iru} \\ \text{mu} \\ \text{naal} \\ \text{aym} \\ \text{aṟu} \\ \text{eḷu} \\ \text{eṇ} \end{bmatrix} + \begin{bmatrix} \text{pattu} + \text{Nu}_1 \\ \\ \\ \\ \\ \\ \text{patu} \end{bmatrix}$$

Ex. iraṇṭu - pattu + Nu_1
iraṇṭu - pattu - aaṟu → iru - pattu - aaṟu
iraṇṭu - pattu → iru - patu

(b)

$$\text{oṉpatu} + \begin{bmatrix}\text{pattu} + \text{Nu} \\ \text{pattu}\end{bmatrix} \Rightarrow \begin{bmatrix}\text{toṇṇuuṟṟu} + \text{Nu}_1 \\ \text{toṇṇuuṟu}\end{bmatrix}$$

Ex. oṉpatu + pattu + Nu_1

oṉpatu + pattu + muuṉṟu → toṇṇuuṟṟu + muuṉṟu

oṉpatu + pattu → toṇṇuuṟu

2.6.2. Tl.

$$\begin{bmatrix}\text{rendu} \\ \text{muudu} \\ \text{naalugu} \\ \text{aydu} \\ \text{aaru} \\ \text{eeḍu} \\ \text{enimidi} \\ \text{tommidi}\end{bmatrix} + \text{padi} \Rightarrow \begin{bmatrix}\text{ira} \\ \text{mu} \\ \text{nalag} \\ \text{eed} \\ \text{ara} \\ \text{eḍ} \\ \text{enam} \\ \text{tomm}\end{bmatrix} + \text{pai}$$

The Telugu forms *iravai, mupphai, nalabhai,* etc., will be obtained only after the morphophonemic rules are applied and this will be dealt with later. The Tamil forms *irupatu, muppatu,* etc. also will be explained later on.

The Tamil form *toṇṇuuṟu* and the Telugu form *tombhai* behave in two different ways. These forms will be taken for discussion somewhere in the following sections.

2.7.1. Tm.

(a)

$$\begin{bmatrix}\text{iraṇṭu} \\ \text{muuṉṟu} \\ \text{naaṉku} \\ \text{ayndu} \\ \text{eṭṭu} \\ \text{onpatu}\end{bmatrix} + \text{aayiram} \Rightarrow \begin{bmatrix}\text{iir} \\ \text{muu} \\ \text{naal} \\ \text{ay} \\ \text{eṇ} \\ \text{onpatiṉ}\end{bmatrix} + \text{aayiram}$$

ay + *aayiram* will give *ayyaayiram* and *eṇ* + *aayiram* will give *eṇṇaayiram*. The geminations of *y* and *ṇ* will be dealt with under the morphophonemic section.

(b)

$$\begin{bmatrix}\text{iraṇṭu} \\ \text{muuṉṟu} \\ \text{naaṉku} \\ \text{ayntu} \\ \text{aaṟu} \\ \text{eeḷu} \\ \text{eṭṭu} \\ \text{oṉpaṭu}\end{bmatrix} + \text{nuuṟu} \Rightarrow \begin{bmatrix}\left.\begin{matrix}\text{iru} \\ \text{mu} \\ \text{naal} \\ \text{ay} \\ \text{aṟu} \\ \text{eḷu} \\ \text{eṇ}\end{matrix}\right\} + \text{nuuṟu} \\ \text{toḷḷaayiram}\end{bmatrix}$$

When *aayiram* and *nuuṟu* are added to Nu_1 in Tamil, the items represented by Nu_1 have to undergo various changes; but in the case of Telugu when *veyyi* or *veelu* and *nuuru*, *onda* or *ondalu* are added to Nu_1 the items represented by Nu_1 do not suffer great changes. Therefore corresponding rules for 2.7.1. a and 2.7.1. b are not framed for Telugu.

(c) Tm.

$$\begin{bmatrix} \text{kooti} \\ \text{ilaṭcam} \\ \text{aayiram} \\ \text{nuuṟu} \end{bmatrix} + X_4 \Rightarrow \begin{bmatrix} \text{kooṭi - yee} \\ \text{ilaṭca - ttu} \\ \text{aayira - ttu} \\ \text{nuuṟ - ṟu} \end{bmatrix} + X_4$$

X_4 stands for all the numerals that can occur after *Kooṭi*, *ilaṭcam*, etc. Here we can treat *-ee* and -ttu as suffixes. In the case of *aayirattu*, *ilaṭcattu* and *nuuṟṟu* it is difficult to decide the suffix. At present we are not dealing with that problem. When one analyses the whole language the suffix can be easily decided and then it will be explained.

2.7.2. Tl.

(a)

$$\begin{bmatrix} \text{Kooṭi} \\ \text{lakṣa} \\ \text{Veyyi} \\ \text{onda} \end{bmatrix} + \text{lu} + X_4 \Rightarrow \begin{bmatrix} \text{Kooti} \\ \text{laksa} \\ \text{Veyyi} \\ \text{Onda} \end{bmatrix} + \text{lu} + \text{a} + X_4$$

(b) nuuru + X_4 $\Rightarrow$ nuuṭa + X_4

-a is an adjectiviser in Telugu. *Veelu* + *a* will give *Veela* (*Veelayiravai* 1,020) When *-a* is added to *nuuṟu* we get *nuuṭa* but here we have treated it otherwise.

Ex.

Tm. eṭṭukkooṭi + aaṟilaṭcam
eṭṭukkooṭiyee - aaṟilaṭcam 80,600,000

Tl. enimidi kooṭilu + aarulakṣalu
enimidikooṭila - aarulkṣalu 80,600,000

Tm. nuuṟu + aympatu → nuuṟṟaympatu 150

Tl. nuuru + eebhai → nuuṭa eebhai 150

2.8. Tm.

Pattu + [{ on̲r̲u, muun̲r̲u, naan̲ku, ayntu, aar̲u, eeḷu, eṭṭu }, iraṇṭu] ⇒ Patin̲ + [{ on̲r̲u, muun̲r̲u, naan̲ku, ayntu, aar̲u, eeḷu, eṭṭu }, Pan̲ + iraṇṭu]

Tl.

padi + [{ okaṭi, muḍu, aaru, aydu, eeḍu }, { reṇḍu, tommidi }, { naalugu, enimidi }] ⇒ [Pada + { koṇḍu, muuḍu, haaru, heenu, heeḍu }, Pan + { eṇḍu, tommidi }, Pad + { naalugu, enimidi }]

Ex.

Tm.	pattu + on̲r̲u	patin̲ - on̲r̲u	11
Tl.	padi + okati	pada - koṇḍu	11

Usually all the Telugu numerals end in *-a* when they are adjectivized. The forms *pada* + *heenu* and *pada* + *heeḍu* will ultimately become *padi heenu* and *padi heeḍu* respectively. It is also possible to analyse *padiheenu* and *padiheeḍu* as *padi* + *heenu* and *padi* + *heeḍu* or *padi* + *eenu* and *padi* + *eeḍu*. It is already mentioned that the Telugu numerals take the suffix *-a* when they are adjectivized and we therefore prefer *pada* - to *padi*-. The change *pada* to *padi* is treated under the morphophonemic section. It is also possible to treat them as *pada* + *eenu* and *pada* + *eedu* and the *h* can be explained as a kind of glide introduced to avoid hiatus. We have taken them as *heenu* and *heedu* in the context *padi* - so that we can save a rule in the analysis.

The resultant forms of Tamil and Telugu can be obtained after we apply the morphophonemic rules given in the following section.

III. MORPHOPHONEMICS

3.0. In this section the morphophonemic rules for Tamil and Telugu are given. There is only one rule which is common for Tamil and Telugu.

3.1. Tm. Tl.

$(c)\ \breve{V}\ c_1 \rightarrow (c)\ \breve{V}\ C_1\ C_1\ //-V$

This is the common rule for Tamil and Telugu as far as the numerals are concerned. V stands for vowels ($\breve{V}$: Short Vowel, $\bar{V}$: long vowel and C for consonants.

Ex. Tm. eṇ + aayiram eṇṇaayiram

Tl. pan + eṇḍu Pannendu

3.2.1. The following are the rules applicable to Tamil numerals.

(a) $X + Cu \rightarrow X + C\ //-V$

X stands for any sequence other than $(C)\breve{V}$

Ex. eeḷu + aayiram → eeḷaayiram		7,000
aaṟu + aayiram → aaṟaayiram		6,000
naaṟpatu + aayiram → naaṟpataayiram		40,000

(b) $C \rightarrow CC\ //\ C\breve{V}-$

Ex. mu + patu	muppatu	30
mu + nuuru	munnuuru	300

(c) n → nn // $\bar{V}$y –

Ex. ay + nuuṟu aynnuuṟu

(d) n → ṇ // ṇ –

Ex. eṇ + nuuru ennuuru

$$(e)\ l \rightarrow \begin{cases} ṟ & -//-p \\ ṉ & //-n \end{cases}$$

Ex. naal + patu naaṟpatu

naal + nuuru *naaṉ + nuuṟu

(f) n → ṉ // ṉ –

Ex. *naaṉ + nuuru *naaṉ + ṉuuṟu

This rule is necessitated because we find forms like *kaṉ – ṉanru* (*kal* + *nanru*) in Tamil. It is possible to avoid this rule

by some other means; but to avoid this rule is to violate the system.

(g) ṉṉ → ṉ // (C) V̄ —
// (C) V(C) V —

Ex. *naaṉ + ṉuuṟu → naaṉuuṟu
*patiṉ + ṉaaṉku → patiṉaaṉku

We get the form *naaṉuuṟu* only after the rules (e), (f) and (g) are applied accordingly.

naal + nuuṟu → naaṉ + nuuṟu (e)
naaṉ + nuuṟu → naaṉ + ṉuuṟu (f)
naaṉ + ṉuuṟu → naaṉuuṟu (g)

(h) uu → uuv // – aa

Ex. muu + aayiram → muuv – aayiram

3.2.2. The following are the rules applicable to Telugu numerals: (V stands for Vowels and C for Consonants):

(a) $t \rightarrow \left\{ \begin{matrix} d \\ d^h \end{matrix} \right\}$ // N –

Ex. Pan + tommidi → $\left\{ \begin{matrix} \text{pandommidi} \\ \text{pand}^h\ \text{ommidi} \end{matrix} \right\}$

(b) p → v // V– V

Ex. iṟa + pai → iṟavai
aṟa + pai → aṟavai

(c) $P \rightarrow b^h$ // $\left\{ \begin{matrix} g \\ d \\ ḍ \\ m \end{matrix} \right\}$ –

Ex. nalag + pai → *nalag + b^h ai
eed + pai → *eed + b^h ai
eḍ + pai → *eḍ + b^h ai
enam + pai → *enam + b^h ai

(d) : $\left\{ \begin{matrix} m \\ g \\ d \end{matrix} \right\} \rightarrow \phi$ // V — b^h

Ex. *enam + b^hai → enab^{h}ai
*nalag + b^hai → nalab^{h}ai
*eed + b^hai → eeb^{h}ai

To get the form *nalab^{h}ai* we have to apply the following rules in the order given.

naalugu + padi → nalag + pai	2.6.2
nalag + pai → nalag + b^{h}ai	3.2.2.c
nalag + b^{h}ai → nalab^{h}ai	3.2.2.d

(e) mm → m // – b^h

The *m* which was *mm* in the input does not become ϕ before b^h. The behaviour of *m* and that of mm are different. Because of this fact the rule (e) has become indispensable. Instead of giving the environment, *V– b^h* in the rule (d), one may be tempted to give the environment, *–b^h* so that he can get *m* from *mm*. But again he gets *m* in the same environment and the rule he preferred will delete that *m* also. In order to surmount this difficulty we prefer the environment *V– b^h* in the rule (d) and thus *mm* in *tomm* – will be left unaffected by the rule (d).

The rules by which we get *tomb^{h}ai* are given below.

tommidi + padi	→	tomm + pai	2.6.2
tomm + pai	→	tomm + b^{h}ai	3.2.2.c
tomm + b^{h}ai	→	tomb^{h}ai	3.2.2 e

(f) eḍ. + b^{h}ai → ḍe + b^{h}ai

By this rule the metathesis is explained and the gemination of *b* in *debb^{h}ai* will be taken care of by the following rule.

(g) $C\breve{V} + \begin{Bmatrix} c^h_1 \\ c_1 \end{Bmatrix} \rightarrow C\breve{V} + C_1 C^h_1$

Ex. de + b^{h}ai → debb^{h}ai
mu + pai → mupp^{h}ai

The form *debb^{h}ai* is obtained as follows:

eeḍu + padi → eḍ + pai	2.6.2
eḍ. + pai → eḍ + b^{h}ai	3.2.2.c
eḍ. + b^{h}ai → ḍe + b^{h}ai	3.2.2.f
ḍe. + b^{h}ai → ḍebb^{h}ai	3.2.2.g

(h) l → ϕ // ṭ – l
Ex. Kooṭi + lu → *kooṭ + lu

(i) l → ḷ // ṭ—

Ex. kooṭ + lu → Kooṭḷu

(j) $\breve{V}_1 + \breve{V}_2 \rightarrow \breve{V}_2$

Ex. aydu + ondalu → aydondalu

reṇḍu – veela + aydondalu → reṇḍuveelaydondalu

(k) a → i // –Cee

Ex. pada + heenu → padiheenu

pada + heedu → padiheedu

IV. GRAMMATICAL ADEQUACY

4.0. There are two ways to test the adequacy of the grammar: (1) Applying the rules and getting the numeral which exists in the language (2) Stating the rules by which we get a given numeral. The difference between (1) and (2) is that we get the numeral at the end of the process in the first case but we have the numeral at the outset of the process in the second case.

4.1. Applying the rules and getting the numeral which exists in the language.

Tamil phrase structure level.

$$Nu$$

$$Nu_a + Nu_1 \qquad 1.1$$

$$Nu_b + Nu_2 + Nu_1 \qquad 1.2.$$

$$Nu_c + Nu_3 + Nu_2 + Nu_1 \qquad 1.3$$

$$Nu_d + Nu_4 + Nu_3 + Nu_2 + Nu_1 \qquad 1.4$$

$$Nu_e + Nu_5 + Nu_4 + Nu_3 + Nu_2 + Nu_1 \qquad 1.5$$

$$Nu + Kooti + Nu_5 + Nu_4 + Nu_3 + Nu_2 + Nu_1 \qquad 1.6$$

$$Nu_1 + Kooti + Nu_5 + Nu_4 + Nu_3 + Nu_2 + Nu_1 \qquad 1.1$$

$$Nu_1 + Kooti + Nu_m + ilatcam + Nu_4 + Nu_3 + Nu_2 + Nu_1 \qquad 1.7$$

$$Nu_1 + Kooti + Nu_1 + ilatcam + Nu_4 + Nu_3 + Nu_2 + Nu_1 \qquad 1.8$$

$$Nu_1 + Kooti + Nu_1 + Ilatcam + Nu_1 + aayiram + Nu_3 + Nu_2 + Nu_1 \qquad 1.9$$

$$Nu_1 + Kooti + Nu_1 + ilatcam + Nu_1 + aayiram + Nu_3 + Nu_2 + Nu_1 \qquad 1.8$$

$$Nu_1 + Kooti + Nu_1 + ilatcam + Nu_1 + aayiram + Nu_1 + Nuuru + Nu_2 + Nu_1 \qquad 1.10$$

Nu_1 + Kooti + Nu_1 + Ilatcam + Nu_1 +
aayiram + Nu_1 + nuuru + Nu_1 + pattu + Nu_1 1.11

on̲r̲u + kooṭi + iraṇṭu + laṭcam + muun̲r̲u +
aayiram + naan̲ku + nuur̲u + ayntu + pattu + aar̲u 1.12

Transformational level

on̲r̲u + kooṭi → oru + kooṭi	2.1
muun̲r̲u + aayiram → muu + aayiram	2.7.1.a
naan̲ku + nuur̲u → naal + nuuru	2.7.1.b
ayntu + pattu → aym + pattu	2.6.1.a
– kooṭi + iraṇṭu – ilaṭcam → kooṭiyee + iraṇṭilaṭcam	2.7.1.C
– ilaṭcam + muu – aayiram → ilaṭcattu + muu – aayiram	2.7.1.C
– aayiram + naal – nuur̲u → aayirattu + naal – nuur̲u	2.7.1.C
– nuur̲u + aympatu → nuur̲r̲u + aympatu	2.7.1.C

Morphophonemic level

iraṇṭu + ilaṭcattu → iraṇṭilaṭcattu	3.2.1.a
nuur̲r̲u + aympattu → nuur̲r̲ – aympattu	3.2.1.a
aympattu + aar̲u → aympattu – aar̲u	3.2.1.a
naal + nuur̲r̲u → naan̲ + nuur̲r̲u	3.2.1.e
naan̲ + nuur̲r̲u → naan̲ + n̲uur̲r̲u	3.2.1.b
naan̲ + n̲uurru → naan̲uur̲u	3.2.1.g
muu + aayirattu → muuvaayirattu	3.2.1.h

As a result of all these processes we get the numeral *oru kooṭiyee iraṇṭilaṭcattu muun̲r̲aayirattu naan̲uur̲r̲aympattaar̲u* (1,02,03,456). Instead of *muun̲r̲aayiram* we can also have *muuvaayiram* (rules 2.7.1.a 3.2.1,h).

Telugu Phrase structure level

Nu	1.1
Nu_a + Nu_1	1.2
Nu_b + Nu_2 + Nu_1	1.3
Nu_4 + Nu_3 + Nu_2 + Nu_1	1.4
Nu_m + Veyyi + Nu_3 + Nu_2 + Nu_1	1.9
Nu_1 + Veyyi + Nu_3 + Nu_2 + Nu_1	1.8
Nu_1 + Veyyi + Nu_1 + Onda + Nu_2 + Nu_1	1.10
Nu_1 + Veyyi + Nu_1 + Onda + Nu_1 + Padi + Nu_1	1.11
Okaṭi + veyyi + reṇḍu + onda + muuḍu + padi + naalugu	1.12

Transformational level

Okaṭi	+ Veyyi	→	Okaveyyi	2.1.
reṇḍu	+ onda	→	rendu + onda + lu	2.5.1.
muuḍu	+ padi	→	mu + pai	2.6.2.
ondalu	+ mu + pai	→	ondalu + a + mu – pai	2.7.2

Morphophonemic level

reṇḍu + onda + lu → reṇḍondalu	3.2.2.j
reṇḍondalu + a → reṇḍondala	3.2.2.j
mu + pai → mup – p^hai	3.2.2.g

Now we get the form *Okaveyyi reṇḍondala mupp^{h}ai* 1,230.

4.2. Stating the rules by which we get a given numeral.

Tamil

Let us choose a numeral and give rules for that item. Suppose, we have the numeral, *naaṟpatteeḷaayirattu munnuṟṟu naaṟpatteṭṭu.* First of all we have to give the phrase structure rules, secondly transformational rules and thirdly morphophonemic rules.

(a) Phrase structure rules.

naaṟpatteeḷaayiram + munnuuṟu + naaṟpatu + eṭṭu

$Nu_4 + Nu_3 + Nu_2 + Nu_1$ 1.4.

We get the sequence $Nu_4 + Nu_3 + NU_2 + Nu_1$ when we go on expanding Nu.

Nu	
$Nu_a + Nu_1$	1.1.
$Nu_b + Nu_2 + Nu_1$	1.2.
$Nu_c + Nu_3 + Nu_2 + Nu_1$	1.3.
$Nu_4 + Nu_3 + Nu_2 + Nu_1$	1.4.

When we go on expanding these constitutents we get the terminal strings which will give the numeral 47,348.

$Nu_4 + Nu_3 + Nu_2 + Nu_1$	1.4.
Nu_m + aayiram + $Nu_3 + Nu_2 + Nu_1$	1.9.
Nu_m + aayiram + Nu_4 + Nuuru + $Nu_2 + Nu_1$	1.10
$Nu_2 + Nu_2$ + aayiram + Nu_1 + nuuru + $Nu_2 + Nu_1$	1.8

Nu_1 + pattu + Nu_1 + aayiram + Nu_1 + nuuru +
Nu_1 + pattu + Nu_1 1.11.

naaṉku + pattu + eeḷu + aayiram + muuṉṟu + nuuṟu +
naaṉku + pattu + eṭṭu 1.12

(b) Transformational rules

naaṉku + pattu + eeḷu → naal + pattu + eeḷu
naaṉku + pattu + eṭṭu → naal + pattu + eṭṭu 2.6.1.a

muuṉṟu + nuuṟu → mu + nuuṟu 2.7.1.b.

nuuṟu + naal – pattu → nuuṟṟu + naal – pattu
aayiram + mu–nuuṟu → aayirattu + mu – nuuṟu 2.7.1.c.

(c) Morphophonemic ruler

naal + pattu → naaṟ – pattu 3.2.1.e

mu + nuurru → mun – nuuṟṟu 3.2.1.b

eeḷu + aayirattu → eeḷ – aayirattu
naaṟpattu + eṭṭu → naaṟpatt – eṭṭu
naaṟpattu + eeḷu → naaṟpatt – eeḷu 3.2.1.a

These rules enable us to generate the numeral *naaṟpatt eeḷaayinttu munnuuṟṟu naaṟpatteṭṭu,* (47,348).

Telugu

Suppose we have the numeral, *okalakṣa padi veela reṇḍondala mupp^hai muuḍu.* Let us try to give the rules by which we get this numeral.

(a) Phrase structure level

okalakṣa + *padiveelu* + *reṇḍondalu* + *mupp^hai* + *muuḍu*

Nu_5 + Nu_4 + Nu_3 + Nu_2 + Nu_1

We can get the sequence $Nu_5 + Nu_4 + Nu_3 + Nu_2 + Nu_1$ starting with the initial string Nu.

Nu

$Nu_a + Nu_1$ 1.1

$Nu_b + Nu_2 + Nu_1$ 1.2

$Nu_c + Nu_3 + Nu_2 + Nu_1$ 1.3

$Nu_d + Nu_4 + Nu_3 + Nu_2 + Nu_1$ 1.4.

$Nu_5 + Nu_4 + Nu_3 + Nu_2 + Nu_1$ 1.5.

When all these constituents are unpacked we get the terminal strings which will give the numeral, 1,10,233

$Nu_5 + Nu_4 + Nu_3 + Nu_2 + Nu_1$ 1.5

Nu_m + lakṣa + $Nu_4 + Nu_3 + Nu_2 + Nu_1$ 1.7

Nu_m + lakṣa + Nu_m + veyyi + $Nu_3 + Nu_2 + Nu_1$ 1.9

Nu_1 + lakṣa + Nu_2 + veyyi + $Nu_3 + Nu_2 + Nu_1$ 1.8

Nu_1 + lakṣa + Nu_2 + veyyi + Nu_2 + onda + $Nu_2 + Nu_1$ 1.10

Nu_1 + lakṣa + padi + veyyi + Nu_1 + onda + Nu_1 + padi + Nu_1 1.11

Okaṭi + lakṣa + padi + veyyi + reṇḍu + onda + muuḍu + padi + muuḍu 1.12

(b) Transformational level

padi + veyyi → padi + veyyi + lu
rendu + onda → rendu + ondu + lu } 2.5.1

muuḍu + padi → mu + pai 2.6,2

veyyi + lu → veelu 2.5.2

veelu → veelu - a
Onda - lu → onda - lu - a } 2.7.2

Okaṭi + lakṣa → Oka + lakṣa 2 1

(c) Morphophonemic level

reṇḍu + ondalu → reṇḍ - ondalu
veelu - a → veela
ondalu - a → ondala } 3.2.2.j

mu + pai → mupp^h^ai 3.2.2.g

With the help of these rules the numeral *oka lakṣa padi veela reṇḍondala mupp^h^ai muuḍu* can be generated.

The rules given under the heads phrase structure, transformation and morphophonemics enable us to generate all the numerals from one to hundred billion (100,000,000,000.000). There is provision to generate still higher units but one may seldom find it necessary. The fractions (½, ¼, etc.) are not dealt with here. This analysis, we hope, will give a clear idea about the structure of Tamil and Telugu numerals.